NONPROVISIONAL PATENT APPLICATION

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

OLIFF & BERRIDGE, PLC
P.O. Box 19928
Alexandria, Virginia 22320
Telephone: (703) 836-6400
Facsimile: (703) 836-2787

Attorney Docket No.: 106656

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BOX PATENT APPLICATION

NONPROVISIONAL APPLICATION TRANSMITTAL
RULE §1.53(b)

Director of the U.S. Patent and Trademark Office
Washington, D.C. 20231

Sir:

Transmitted herewith for filing under 37 C.F.R. §1.53(b) is the nonprovisional patent application

For (Title): THERMAL TRANSFER RECORDING MEDIA

By (Inventors): Toshimichi HARADA and Yoichi SHUTARA

- ☒ Formal drawings (Figs. 1-2; 1 sheet) are attached.
- ☒ A Declaration and Power of Attorney is filed herewith.
- ☐ An assignment of the invention to _____ is filed herewith.
- ☐ An Information Disclosure Statement is filed herewith.
- ☐ A statement to establish small entity status under 37 C.F.R. §§1.9 and 1.27 is filed herewith.
- ☐ A Preliminary Amendment is filed herewith.
- ☐ Please amend the specification by inserting before the first line the sentence --This nonprovisional application claims the benefit of U.S. Provisional Application No. _____, filed _____.--
- ☒ Priority of foreign application No. JP-Hei 11-196876 filed July 12, 1999 in Japan is claimed (35 U.S.C. §119).
- ☐ A certified copy of the above corresponding foreign application(s) is filed herewith.
- ☒ The filing fee is calculated below:

CLAIMS IN THE APPLICATION AFTER ENTRY OF
ANY PRELIMINARY AMENDMENT NOTED ABOVE

FOR:	NO. FILED	NO. EXTRA	SMALL ENTITY RATE	SMALL ENTITY FEE	OR	OTHER THAN A SMALL ENTITY RATE	OTHER THAN A SMALL ENTITY FEE
BASIC FEE				$ 345	OR		$ 690
TOTAL CLAIMS	24 - 20	= 4	x 9 =	$	OR	x 18	$72
INDEP CLAIMS	- 3	= *	x 39 =	$	OR	x 78	$0
☐ MULTIPLE DEPENDENT CLAIMS PRESENTED			+130 =	$	OR	+260	$0
			TOTAL	$	OR	TOTAL	$762

* If the difference is less than zero, enter "0".

- ☒ Check No. 109961 in the amount of $762 to cover the filing fee is attached. Except as otherwise noted herein, the Director is hereby authorized to charge any other fees that may be required to complete this filing, or to credit any overpayment, to Deposit Account No. 15-0461. Two duplicate copies of this sheet are attached.
- ☐ This application is entitled to small entity status. DO NOT charge large entity fees to our Deposit Account.

Respectfully submitted,

James A. Oliff
Registration No. 27,075

Thomas J. Pardini
Registration No. 30,411

JAO:TJP/trb

Inventor Information

Inventor One Given Name::	Toshimichi
Family Name::	Harada
Name Suffix::	
City of Residence::	Tochigi
State or Prov. of Residence::	
Country of Residence::	Japan
Inventor Two Given Name::	Yoichi
Family Name::	Shutara
Name Suffix::	
City of Residence::	Tochigi
State or Prov. of Residence::	
Country of Residence::	Japan
Inventor Three Given Name::	
Family Name::	
Name Suffix::	
City of Residence::	
State or Prov. of Residence::	
Country of Residence::	
Inventor Four Given Name::	
Family Name::	
Name Suffix::	
City of Residence::	
State or Prov. of Residence::	
Country of Residence::	
Inventor Five Given Name ::	
Family Name::	
Name Suffix::	
City of Residence::	
State or Prov. of Residence::	
Country of Residence::	

Correspondence Information

Name Line One::	Oliff & Berridge PLC
Address Line One::	P.O. Box 19928
City::	Alexandria
State or Province::	VA
Postal or Zip Code::	22320
Telephone::	(703) 836-6400
Fax::	(703) 836-2787
Electronic Mail::	commcenter@oliff.com

Application Information

Title Line One::	Thermal Transfer Recording Media
Title Line Two::	
Title Line Three::	
Title Line Four::	

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Continuity Information

>This application is a::
Application One::
Filing Date::
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Prior Foreign Applications

Foreign Application One:: 11-196876
Filing Date:: July 12, 1999
Country:: Japan
Priority Claimed:: Yes
Foreign Application Two::
Filing Date::
Country::
Priority Claimed::
Foreign Application Three::
Filing Date::
Country::
Priority Claimed::

THERMAL TRANSFER RECORDING MEDIA

FIELD OF THE INVENTION

This invention relates to thermal transfer recording media to be used for, e.g., thermal transfer printers.

BACKGROUND OF THE INVENTION

In the field of thermal transfer printers, edge head printers have been widely employed in these years.

These edge head printers have advantages of achieving a high printing speed (about 8 inch/sec) in spite of the simple structure thereof and being applicable to recording media having rough surface such as non-coated paper (so-called rough paper).

Fig. 2 shows an example of conventionally known thermal transfer recording media for these edge head printers.

In this thermal transfer recording medium 101 shown in Fig. 2, a peel layer 103 is formed on a base material 102 and a highly viscous ink layer 104 is further formed on the peel layer 103. On the other hand, a heat-resistant lubricating layer 105 is formed on the opposite face of the base material 102.

In recent years, printing speed has been more and more elevated (about 12 inch/sec). Therefore, it is impossible under the present conditions to obtain a clear image by printing

on non-coated paper at a high speed.

In high-speed printing, there arises another problem that the resistance to rubbing (rub resistance) of the printed image is worsened.

The present invention, which has been completed to solve these problems encountering in the prior art, aims at providing thermal transfer recording media capable of providing a clear image in case of high-speed printing on non-coated paper and improving the rub resistance.

SUMMARY OF THE INVENTION

To achieve the object as described above, the present invention provides a thermal transfer recording medium comprising of a base material and a peel layer including a wax (A) and an ink layer including a styrene resin (B), a binder component (C) and a coloring component (D) laminated successively on the base material, wherein the wax (A) is compatible with the styrene resin (B).

The present inventor conducted studies on the transfer of a thermal transfer recording medium for non-coated paper. As a result, it has been found out that as the printing speed is elevated, no transfer occurs at the interface of the base material and the peel layer at the area to be peeled but peeling arises at the inner part of the peel layer. The peeling finally moves at the interface of the peel layer and the ink layer.

By using a peel layer including a wax (A) and an ink layer including a styrene resin (B) compatible with the wax (A), the peel layer sufficiently adheres to the ink layer even at the step of heat transfer. Thus, no peeling arises at the interface of the peel layer and the ink layer. The peel layer and the ink layer are transferred together from the base material, thereby ensuring smooth transfer of the ink layer and sufficient protection after the completion of printing.

According to the present invention, therefore, a clear image can be obtained and the rub resistance can be improved even in case of printing on non-coated paper at a high speed.

In the present invention, it is also effective to regulate the weight ratio of the styrene resin (B) to the binder component (C) to 10:90 to 50:50.

According to the present invention, the sharpness and rub resistance of a printed area can be improved.

When a binder component (C) including an ethylene-vinyl acetate copolymer is employed as in the present invention, the ink layer has a high viscosity and thus bleeding into non-coated paper can be prevented, thereby providing a clear image. In this case, moreover, a rubbery elasticity can be imparted to the ink layer and thus the rub resistance can be elevated.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a sectional view showing the constitution of

the thermal transfer recording medium according to the present invention.

Fig. 2 is a sectional view showing the constitution of a conventional thermal transfer recording medium.

In these figures, each numerical symbol has the following meaning:

1 : thermal transfer recording medium

2 : base material

3 : peel layer

4 : ink layer

5 : heat-resistant lubricating layer.

DETAILED DESCRIPTION OF THE INVENTION

Next, embodiments of the thermal transfer recording medium according to the present invention will be described in greater detail by reference to the attached drawings.

In the thermal transfer recording medium of the present invention, for example, a peel layer 3 and an ink layer 4 are successively formed on one face of a base material 2 as shown in Fig. 1. On the other face of the base material 2, a heat-resistant lubricating layer 5 is formed.

As the base material 2 to be employed in the present invention, use can be made of base materials employed in conventional thermal transfer recording media. For example, it is appropriate to use a base material made of paper such as

condenser paper or parchment paper or a base material made of plastics such as a polyester film, a polyvinyl chloride film or a polycarbonate film.

From the viewpoints of the strength and heat transfer of the film, the thickness of this base material 2 preferably ranges from 2 to 15 μm, more preferably from 3 to 10 μm.

On the other hand, the function of the peel layer 3 is to improve the transfer properties of the ink layer 4 in the step of heat transfer. Under ordinary conditions (i.e., not in the step of heat transfer), the peel layer well adheres to the base material 2 and the ink layer 4 to thereby contribute to the prevention the ink layer 4 from scaling off.

The peel layer 3 of the present invention includes a wax (A).

Although the type of the wax (A) is not restricted in the present invention, it is preferable to use a wax having a melting point of from 50 to 90°C, more preferably from 65 to 75°C, from the viewpoint of improving the applicability to non-coated paper.

Examples of such a wax (A) include carnauba wax, candelilla wax, lanolin wax, rice wax and oxide wax.

Among these waxes, candelilla wax is particularly preferable from the viewpoint of improving the applicability to non-coated paper.

To prevent ink fall-out, it is also possible to add a

thermoplastic elastomer such as polystyrene-polybutylene-polystyrene (SBS) to the above-described wax.

The thickness of the peel layer 3 may vary over a wide range by considering other factors, for example, the materials of other units such as the base material 2 and the ink layer 4 and the printing conditions. From the viewpoints of the printing energy, coating properties and printing qualities, the thickness of the peel layer preferably ranges from 0.3 to 2.0 g/m^2.

On the other hand, the ink layer 4 in the present invention includes a styrene resin (B), a binder component (C) and a coloring component (D).

In this case, a styrene resin (B) being compatible with the above-described wax (A) is used. The term "styrene resin" as used in the present invention involves both polymers and oligomers.

The term "compatible with" as used in the present invention means that the wax (A) and the styrene resin (B) do not separated from each other within a weight ratio range of 10:90 to 90:10, when they are molten together by heating at a temperature higher by 30°C or more than the melting points of these components.

In the present invention, the weight ratio of the styrene resin (B) to the binder component (C) preferably ranges from 10:90 to 50:50, more preferably from 20:80 to 40:60.

When the weight ratio of the styrene resin (B) to the

binder component (C) is less than 10:90, there arises a problem that the rub resistance is worsened after printing. When the weight ratio exceeds 50:50, on the other hand, there arises another problem that the sharpness and rub resistance of a printed area are worsened particularly in case of high-speed printing.

It is preferable to use a binder component (C) having a melt index of from 3 to 1,000, more preferably from 60 to 400.

When the melt index of the binder component (C) is less than 3, there arises a problem that the sharpness of a printed area is worsened. When the melt index exceeds 1,000, there arises another problem that the applicability to non-coated paper is worsened.

As an example of such binder component (C), an ethylene-vinyl acetate copolymer (EVA) may be cited.

As the coloring component (D), on the other hand, use can be made of coloring components employed in conventional thermal transfer recording media. For example, carbon black and color pigments are appropriately usable therefor.

The heat-resistant lubricating layer 5 in the present invention is formed by using, for example, a publicly known silicone copolymer or silicone oil.

<Examples>

The thermal transfer recording media according to the present invention will be described in detail by reference to

the following Examples and Comparative Examples.

Table 1 shows the properties of each component employed in Examples and Comparative Examples, while Table 2 summarizes the evaluation data of the samples of Examples and Comparative Examples.

Table1:properties of each component

	Product	Manufacturer	Melt index
Binder component (C) (EVA)	KA31	Sumitomo Chemical Co.,Ltd.	3
	MB11	Sumitomo Chemical Co.,Ltd.	60
	KC10	Sumitomo Chemical Co.,Ltd.	150
	KE10	Sumitomo Chemical Co.,Ltd.	300
	Ultrasen725	Tosoh Corporation	1000
	Product	Manufacturer	Softening point (℃)
Styrene resin (B)	FTR8100	Mitsui Petrochemical Industries, Ltd.	100
	Kristalex 3100	Rika-Hercules	100
	Product	Manufacturer	M. p. (℃)
Wax (A)	Candelillawax	Kato Yoko K.K.	70
	Carunaba wax	Kato Yoko K.K.	83

Table 2: Evaluation data of Examples and Comparative examples

	Ink layer			Peel layer component	8 ips			12 ips		
	Component				Applicability to non-coated paper	Sharpness	Rub resistance	Applicability to non-coated paper	Sharpness	Rub resistance
	styrene resin(B)	Binder(C)	Ratio							
Ex. 1	FTR8100	MB11	30/70	Candelilla wax	○	○	○	○	○	○
C. Ex. 1	—	MB11	0/100	Candelilla wax	○	○	×	○	△	×
Ex. 2	FTR8100	KE10	30/70	Candelilla wax	○	○	○	○	○	○
C. Ex. 2	—	KE10	0/100	Candelilla wax	○	○	×	○	○	×
Ex. 3	FTR8100	KC10	30/70	Candelilla wax	○	○	○	○	○	○
C. Ex. 3	—	KC10	0/100	Candelilla wax	○	○	×	○	○	×
Ex. 4	FTR8100	KC10	10/90	Candelilla wax	○	○	△	○	○	△
Ex. 5	FTR8100	KC10	50/50	Candelilla wax	○	○	○	△	△	○
Ex. 6	FTR8100	KA31	30/70	Candelilla wax	○	△	○	○	△	○
Ex. 7	FTR8100	Ultrasen 725	30/70	Candelilla wax	○	○	○	△	○	○
Ex. 8	FTR8100	KC10	30/70	Carunaba wax	○	○	○	△	○	○
C. Ex. 4	Kristalex 3100	KC10	30/70	Candelilla wax	○	○	△	○	△	×

<Example 1>

(Preparation of heat-resistant lubricating layer composition)

5 parts by weight of an acrylic-silicone graft resin (US380 manufactured by Toagosei Chemical Industry, Co., Ltd.) was dissolved in 95 parts by weight of methyl ethyl ketone employed as a solvent to give the aimed heat resistant lubricating layer composition.

(Preparation of peel layer forming composition)

20 parts by weight of candelilla wax (Candelilla Wax manufactured by Kato Yoko K.K.) was dissolved in 80 parts by

weight of toluene employed as a solvent to give the aimed peel layer-forming composition.

(Preparation of ink layer forming composition)

6 parts by weight of FTR8100 (manufactured by Mitsui Petrochemical Industries, Ltd.) employed as the styrene resin (B), 14 parts by weight of an EVA (MB11 manufactured by Sumitomo Chemical Co., Ltd.; melt index: 60) employed as the binder component (C) and 6 parts by weight of carbon black (MONARCH120 manufactured by Cabot) employed as the coloring component (D) were dissolved under heating to 70°C in 80 parts by weight of toluene employed as a solvent. Then the obtained solution was cooled while stirring with a stirrer to give the aimed ink layer forming composition.

In this Example, the weight ratio of the styrene resin (B) to the binder component (C) was 30:70.

(Formation of thermal transfer recording medium)

By using the heat-resistant lubricating layer composition as described above, a heat-resistant lubricating layer was formed by the gravure coating method on one face (the back side) of a polyethylene terephthalate (PET) film (F5 manufactured by Teijin Ltd.) of 5 μm in thickness and then the solvent was vaporized.

By using the peel layer forming composition as described above, a peel layer was next formed by the gravure coating method on the other face (the front side) of the above-described PET

film and then the solvent was vaporized.

By using the ink layer forming dispersion as described above, an ink layer was further formed by the gravure coating method on the above-described peel layer and the solvent was vaporized. After curing at 50°C for 168 hours, the aimed thermal transfer recording medium was obtained.

The heat-resistant lubricating layer had a thickness of 0.1 μm, the peel layer had a thickness of 1.5 μm and the ink layer had a thickness of 1.5 μm.

<Example 2>

A thermal transfer recording medium was formed as in Example 1 but using another EVA (KE10 manufactured by Sumitomo Chemical Co., Ltd.; melt index: 300) as the binder component (C).

In this Example, the weight ratio of the styrene resin (B) to the binder component (C) was 30:70.

<Example 3>

A thermal transfer recording medium was formed as in Example 1 but using another EVA (KC10 manufactured by Sumitomo Chemical Co., Ltd.; melt index: 150) as the binder component (C).

In this Example, the weight ratio of the styrene resin (B) to the binder component (C) was 30:70.

<Example 4>

A thermal transfer recording medium was formed as in

Example 3 but regulating the weight ratio of the styrene resin (B) to the binder component (C) to 10:90.

<Example 5>

A thermal transfer recording medium was formed as in Example 3 but regulating the weight ratio of the styrene resin (B) to the binder component (C) to 50:50.

<Example 6>

A thermal transfer recording medium was formed as in Example 1 but using another EVA (KA31 manufactured by Sumitomo Chemical Co., Ltd.; melt index: 3) as the binder component (C).

In this Example, the weight ratio of the styrene resin (B) to the binder component (C) was 30:70.

<Example 7>

A thermal transfer recording medium was formed as in Example 1 but using another EVA (ULTRACEN 725 manufactured by Tosoh Corporation; melt index: 1000) as the binder component (C).

In this Example, the weight ratio of the styrene resin (B) to the binder component (C) was 30:70.

<Example 8>

A thermal transfer recording medium was formed as in Example 3 but using carnauba wax (Carnauba Wax manufactured by Kato Yoko K.K.) as the wax (A).

In this Example, the weight ratio of the styrene resin (B) to the binder component (C) was 30:70.

<Comparative Example 1>

A thermal transfer recording medium was formed as in Example 1 but preparing the ink layer forming composition by using an EVA (MB11 manufactured by Sumitomo Chemical Co., Ltd.; melt index: 60) alone without blending any styrene resin (B).

<Comparative Example 2>

A thermal transfer recording medium was formed as in Example 1 but preparing the ink layer forming composition by using an EVA (KE10 manufactured by Sumitomo Chemical Co., Ltd.; melt index: 300) alone without blending any styrene resin (B).

<Comparative Example 3>

A thermal transfer recording medium was formed as in Example 1 but preparing the ink layer forming composition by using an EVA (KC10 manufactured by Sumitomo Chemical Co., Ltd.; melt index: 150) alone without blending any styrene resin (B).

<Comparative Example 4>

A thermal transfer recording medium was formed as in Example 3 but using a styrene resin (B) (Kristalex 3100 manufactured by Rika-Hercules) not compatible with the wax (A).

(Evaluation)

The thermal transfer recording media as described above were evaluated in the following items. Table 2 summarizes the results.

1. Applicability to non-coated paper

Applicability to non-coated paper was evaluated based on

a bar code image printed on non-coated paper (Vellum, manufactured by Stielow) with HV50 (middle power) at a printing speed of 8 or 12 inch/sec with the use of a thermal transfer printer (Bar Code Printer TTX650 manufactured by AVERY). Table 2 shows the results.

In this Table, "O" stands for showing no missing print and "Δ" stands for showing some missing print but being usable in practice.

2. Sharpness

Sharpness of a printed area was evaluated based on a bar code image printed on non-coated paper (Vellum, manufactured by Stielow) with the use of the above-described thermal transfer printer under the same conditions as defined above. Table 2 shows the results.

In this Table, "O" stands for showing neither cutout or dragging of the bar code image, and "Δ" stands for showing some cutout or dragging but being usable in practice.

3. Rub resistance

By using a rubbing tester (AB301 Rubbing Tester manufactured by Tester Sangyo K.K.), a 200 g or 800 g spindle was slid back and forth 20 times on a coated paper piece (K8TB manufactured by TEC, 1 cm x 1 cm) having been printed under the conditions as defined above. Then stains thus formed were evaluated with the naked eye. Table 2 summarizes the results.

In this Table, "O" stands for showing no cutout of the

image, "Δ" stands for showing some cutout of the image but being usable in practice, and "x" stands for being impossible to read the image.

As Table 2 shows, the thermal transfer recording media of Examples 1 to 8 provided each clear printing qualities and sharp image sharpness even in case of printing on non-coated paper at the maximum printing speed (12 ips).

In contrast, the thermal transfer recording media of Comparative Examples 1 to 4 achieved each a pretty good applicability to non-coated paper but showed a very poor rub resistance in both of the cases of printing at 8 and 12 inch/sec.

As discussed above, the present invention makes it possible to provide a highly sharpness and clear image even in case of printing on non-coated paper at a high speed.

The present invention also makes it possible to improve the rub resistance of a printed area after the completion of printing.

WHAT IS CLAIMED IS:

1. A thermal transfer recording medium comprising of:

a base material in the form of a thin film;

a peel layer laminated on said base material and including a wax (A); and

an ink layer laminated on said peel layer and including a styrene resin (B), a binder component (C) and a coloring component (D);

wherein said wax (A) is compatible with said styrene resin (B).

2. The thermal transfer recording medium as claimed in claim 1, wherein said wax (A) has a melting point of from 50 to 90°C.

3. The thermal transfer recording medium as claimed in claim 1, wherein said wax (A) is candelilla wax.

4. The thermal transfer recording medium as claimed in claim 1, wherein said binder component (C) has a melt index of from 3 to 1,000.

5. The thermal transfer recording medium as claimed in claim 2, wherein said binder component (C) has a melt index of from 3 to 1,000.

6. The thermal transfer recording medium as claimed in claim 3, wherein said binder component (C) has a melt index of from 3 to 1,000.

7. The thermal transfer recording medium as claimed in claim 1, wherein the weight ratio of said styrene resin (B) to said binder component (C) is from 10:90 to 50:50.

8. The thermal transfer recording medium as claimed in claim 2, wherein the weight ratio of said styrene resin (B) to said binder component (C) is from 10:90 to 50:50.

9. The thermal transfer recording medium as claimed in claim 3, wherein the weight ratio of said styrene resin (B) to said binder component (C) is from 10:90 to 50:50.

10. The thermal transfer recording medium as claimed in claim 4, wherein the weight ratio of said styrene resin (B) to said binder component (C) is from 10:90 to 50:50.

11. The thermal transfer recording medium as claimed in claim 5, wherein the weight ratio of said styrene resin (B) to said binder component (C) is from 10:90 to 50:50.

12. The thermal transfer recording medium as claimed in

claim 6, wherein the weight ratio of said styrene resin (B) to said binder component (C) is from 10:90 to 50:50.

13. The thermal transfer recording medium as claimed in claim 1, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

14. The thermal transfer recording medium as claimed in claim 2, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

15. The thermal transfer recording medium as claimed in claim 3, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

16. The thermal transfer recording medium as claimed in claim 4, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

17. The thermal transfer recording medium as claimed in claim 5, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

18. The thermal transfer recording medium as claimed in claim 6, wherein said binder component (C) includes an

ethylene-vinyl acetate copolymer.

19. The thermal transfer recording medium as claimed in claim 7, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

20. The thermal transfer recording medium as claimed in claim 8, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

21. The thermal transfer recording medium as claimed in claim 9, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

22. The thermal transfer recording medium as claimed in claim 10, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

23. The thermal transfer recording medium as claimed in claim 11, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

24. The thermal transfer recording medium as claimed in claim 12, wherein said binder component (C) includes an ethylene-vinyl acetate copolymer.

ABSTRACT

Thermal transfer recording media which make it possible to provide a highly sharpness and clear image even in case of printing on non-coated paper at a high speed and to improve the rub resistance of a printed area after the completion of printing.

The present invention provides a thermal transfer recording medium comprising of a base material and a peel layer including a wax (A) and an ink layer including a styrene resin (B), a binder component (C) and a coloring component (D) laminated successively on the base material, wherein the wax (A) is compatible with the styrene resin (B).

In the present invention, it is preferable that the weight ratio of the styrene resin (B) to the binder component (C) preferably ranges from 10:90 to 50:50.

Fig.1

1

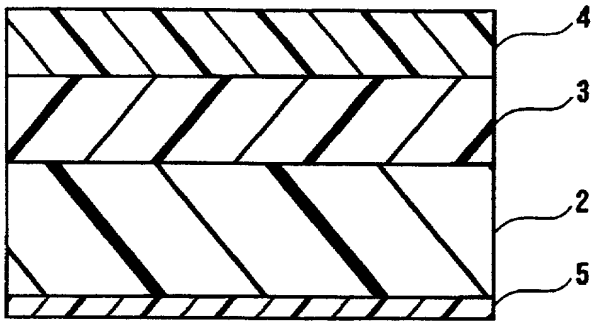
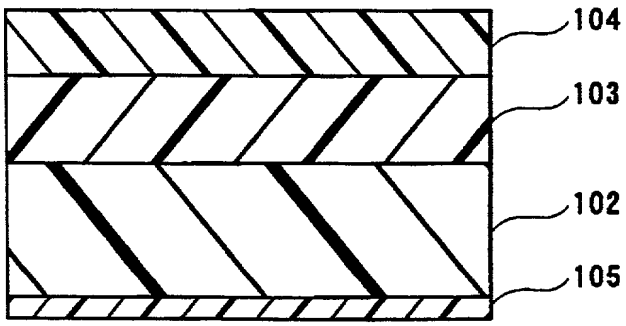


Fig.2 PRIOR ART

101



Docket No.: 106656

APPLICATION FOR UNITED STATES PATENT
DECLARATION AND POWER OF ATTORNEY

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name; that

I verily believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural inventors are named below) of the subject matter which is claimed and for which a patent is sought on the invention entitled: THERMAL TRANSFER RECORDING MEDIA

described and claimed in the specification:

Check one

*a. ☐ attached hereto.

b. ☐ filed on _____ as Application No. _____ and amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

Under Title 35, U.S. Code §119, the priority benefits of the following foreign application(s) and/or United States provisional application(s) filed within one year prior to this application are hereby claimed:

Japanese Patent Application No.11-196876 filed July 12, 1999

The following application(s) for patent or inventor's certificate on this invention were filed in countries foreign to the United States of America either (a) more than one year prior to this application, or (b) before the filing date of the above-named foreign priority application(s) and/or United States provisional application(s):

I hereby appoint the following as my attorneys of record with full power of substitution and revocation to prosecute this application and to transact all business in the Patent Office:

James A. Oliff, Reg. No. 27,075; William P. Berridge, Reg. No. 30,024; Kirk M. Hudson, Reg. No. 27,562; Thomas J. Pardini, Reg. No. 30,411; Edward P. Walker, Reg. No. 31,450; Robert A. Miller, Reg. No. 32,771 and Mario A. Costantino, Reg. No. 33,565.

ALL CORRESPONDENCE IN CONNECTION WITH THIS APPLICATION SHOULD BE SENT TO OLIFF & BERRIDGE, PLC, P.O. BOX 19928, ALEXANDRIA, VIRGINIA 22320, TELEPHONE (703) 836-6400.

I hereby declare that I have reviewed and understand the contents of this Declaration, and that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1 *Typewritten Full Name of First or Sole Inventor*

Given Name	Middle Initial	Family Name
TOSHIMICHI		HARADA

2 **Inventor's Signature: Toshimichi Harada

3 **Date of Signature:

Month	Day	Year
June	22	2000

Residence: TOCHIGI (City) JAPAN (Country)

Citizenship: JAPANESE

Post Office Address (Insert complete mailing address, including country): c/o Sony Chemicals Corp. Dai-1 Factory, 18, Satsuki-cho Kanuma-shi, Tochigi JAPAN

*If Box (a.) is checked, this form may be executed only when attached to the specification (including claims).

**Note to Inventor: Please sign name exactly as it appears above and insert actual date of signing.

IF THERE IS MORE THAN ONE INVENTOR USE PAGE 2 AND PLACE AN "X" HERE ☐

10/96

(Discard this page in a sole inventor application)

1 *Typewritten Full Name of Joint Inventor* YOICHI SHUTARA
Given Name Middle Initial Family Name

2 **Inventor's Signature:** Yoichi Shutara

3 **Date of Signature:** June 22 2000
Month Day Year

Residence: TOCHIGI JAPAN
City State or Province Country

Citizenship: JAPANESE

Post Office Address: (Insert complete mailing address, including country) c/o Sony Chemicals Corp. Dai-1 Factory 18, Satsuki-cho Kanuma-shi, Tochigi JAPAN

1 *Typewritten Full Name of Joint Inventor*
Given Name Middle Initial Family Name

2 **Inventor's Signature:**

3 **Date of Signature:**
Month Day Year

Residence:
City State or Province Country

Citizenship:

Post Office Address: (Insert complete mailing address, including country)

1 *Typewritten Full Name of Joint Inventor*
Given Name Middle Initial Family Name

2 **Inventor's Signature:**

3 **Date of Signature:**
Month Day Year

Residence:
City State or Province Country

Citizenship:

Post Office Address: (Insert complete mailing address, including country)

1 *Typewritten Full Name of Joint Inventor*
Given Name Middle Initial Family Name

2 **Inventor's Signature:**

3 **Date of Signature:**
Month Day Year

Residence:
City State or Province Country

Citizenship:

Post Office Address: (Insert complete mailing address, including country)

Note to Inventor: Please sign name on line 2 exactly as it appears in line 1 and insert the actual date of signing on line 3.

This form may be executed only when attached to the first page of the Declaration and Power of Attorney of the application to which it pertains.